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The Ripening and Repacking of Mature-Green Tomatoes

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CONTENTS

	Page		Page
Introduction	1	Ethylene treatment	4
Equipment	2	Ripening and repacking procedure	5
The ripening room	2	Decay	6
Air conditioning	2	Sanitation	7
Temperature and humidity	4	Summary	7
Air circulation	4		

INTRODUCTION

Tomatoes for the winter and spring fresh markets are largely grown in Florida, California, Texas, Mississippi, and Tennessee. These supplies are augmented by considerable quantities from Mexico and Cuba early in the winter.

Because tomatoes reach a stage of maturity in which they can be harvested several days before they show any trace of pink or red and still be ripened, they are grown in the sections mentioned and shipped long distances to market. Fruits picked in this so-called mature-green stage are practically full grown, and the interior ripening processes are well under way. Such tomatoes, known on the markets as "green-wraps," usually ripen somewhat in transit and some of the fruits may develop a pink or red color.

The ripening and repacking of these tomatoes for the retail trade has become an established and specialized business in many of the larger cities, from which the ripened and repacked fruit is distributed into the surrounding territory. Some of the best methods employed in this practice and the equipment needed, especially for those who wish to operate commercially on a relatively small scale, are described in this circular.

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EQUIPMENT

The ripening of tomatoes is not particularly difficult and can be done on either a large or a small scale, if certain fundamental procedures are understood. Suitable ripening equipment is essential.

The Ripening Room

It is usually advisable to have a ripening room with a capacity of about one carload, or about 300 to 350 square feet of floor space, although a smaller room can be used if tomatoes are to be handled in smaller quantities. The room should be sufficiently insulated so that the temperature can be regulated without undue expense for heat or refrigeration. The kind and amount of insulation needed will depend entirely on the climate and location. The walls and floors should be of smooth, waterproof finish so that they can be washed or disinfected and otherwise kept in a sanitary condition.

Air Conditioning

Heat will be necessary much of the time in the ripening room, and this can be obtained by the use of a stove or a radiator, or by electricity. Electric heat is much the easiest to regulate. If the room is properly insulated the cost for heating should be low, regardless of the source of heat. Rather high atmospheric humidity in the ripening room is necessary to prevent wilting or loss of water in the tomatoes. The humidity can be increased by placing a wide shallow vessel of water on the stove or radiator, or, if steam heat is used, live steam can be valved into the room. Also, fine-spray jets may be installed in an overhead water line, if sufficient tap-water pressure is available, or water may be sprayed on the floors and along the sides of the lugs, taking care not to wet the tomatoes. This latter method of introducing moisture, however, should only be used as a last resort, when it is impossible to provide moisture by the other more desirable methods.

A reliable thermometer for periodic checking of the temperature should be kept in the ripening room at all times. A sling psychrometer should be used to determine the relative humidity of the air.

There are many types of air-conditioning equipment that can be used in the ripening room. It is not the purpose of this circular to recommend any particular set-up, but two simple and inexpensive arrangements are suggested. These may be varied to suit the individual needs of the operator. The circulation of air can be accomplished with an ordinary office fan mounted at one end of the room so as to blow across the tops of the stacks (fig. 1, *B*). The fan can be mounted directly on the wall without using the duct as illustrated, but better distribution of heat can be obtained with the duct. A somewhat more effective system is one in which a blower, such as is used in domestic heating plants, with sufficient air-circulating capacity is installed on the wall near the ceiling and connected with metal ducts, so that air will be picked up near the floor and discharged across the top of the room (fig. 1, *A*). The thermostat furnished with many of these "buckwheat" or heating-plant blowers can be utilized to control

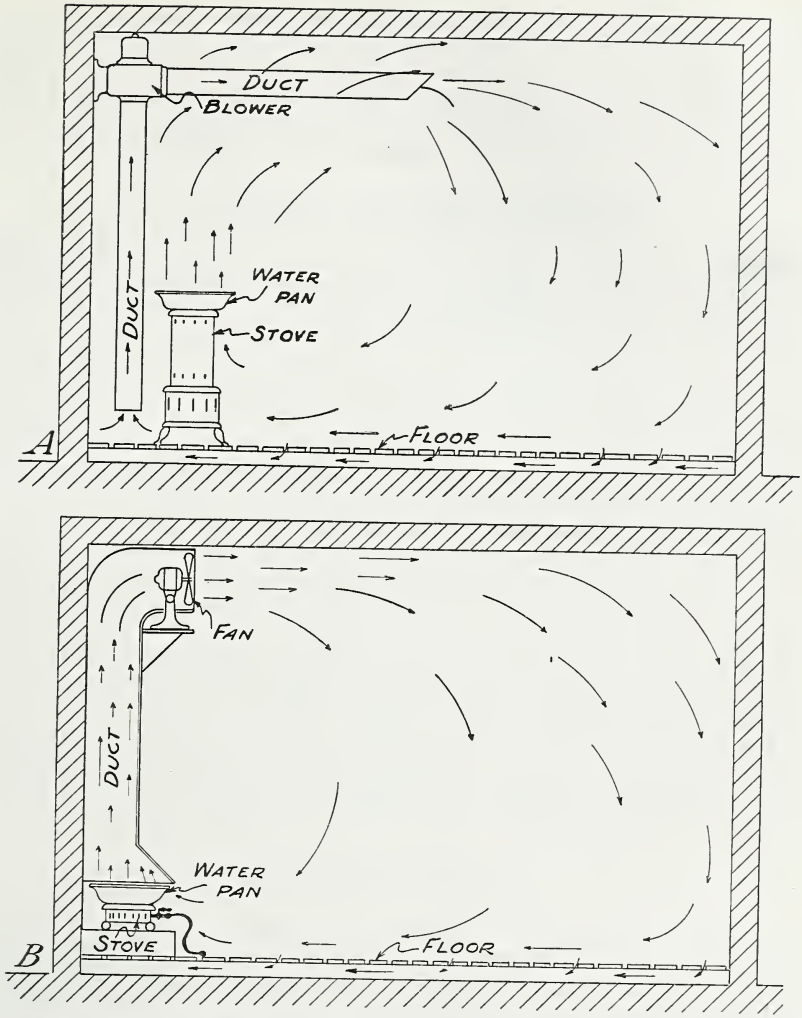

FIGURE 1.—Two simple arrangements for air conditioning a tomato-ripening room.

the temperature, if automatic temperature control is desired. If electric heat is not used, a solenoid valve will be needed to control the operation of the heater. Manual control, however, is satisfactory if the room can be visited periodically and the temperature and humidity are carefully checked. The slatted false floor shown in both arrangements is desirable, because it allows air circulation beneath the stacks of tomatoes. A substitute for such a floor can be provided by stacking the tomatoes on 2- by 2- or 2- by 4-inch stringers laid on the floor. These, however, interfere with the trucking of crates in and out of the room.

Larger operators and those not wishing to assume the responsibility of equipping their own ripening rooms will doubtless employ ex-

perienced engineers to design and install equipment suited to individual requirements or special local conditions. Such equipment should provide means for either heating or refrigerating the air to maintain the desired temperature. This is usually accomplished in a separate conditioning chamber, located either outside or inside the ripening room, where the air is also properly humidified before being returned.

TEMPERATURE AND HUMIDITY

Ripening temperatures range from 55° to 72° F., varying with the market demand. Where maximum speed in ripening is desired because of an active market, temperatures of 70° or 72° may be used. It should be understood, however, that where such high temperatures are used, considerably more decay will develop, and for this reason the tomatoes may not hold up as long as when lower ripening temperatures are used. At temperatures of 80° or above, the coloring is apt to be uneven or blotched. When speed is not greatly desired and a firm product of good color and maximum quality is wanted, a ripening temperature near 60° can be utilized. The lowest temperature at which tomatoes will color satisfactorily, although very slowly, is about 55°. Experienced operators consider 65° to 68° the most satisfactory temperature to use under average conditions. At these temperatures mature-green tomatoes should ripen in 4 to 5 days, "turning" tomatoes in 2 days, and "pinks" in 1 day. If, after tomatoes have started to ripen, it is desirable to hold them over a few days the temperature can be lowered safely to 60°, or even to 55° to retard the ripening process. Some operators believe that if the temperature is lowered after ripening begins, a better color finally results. For the storage of tomatoes either before or after ripening it is not advisable to use a temperature much below 55°. The relative humidity of the ripening room should be maintained at 90 to 95 percent.

AIR CIRCULATION

Constant air circulation should be provided to insure uniform temperature and humidity in all parts of the room. At times the introduction of outside air may be desirable to freshen the atmosphere or to reduce the temperature or humidity, but under ordinary conditions this is not necessary. It is thought by some that the gaseous products given off during ripening are beneficial and should be retained in the room as much as possible. When filling the room, the stacks of lug boxes should be set at least 2 inches apart to insure air circulation around all sides.

ETHYLENE TREATMENT

Ethylene is sometimes used on tomatoes that are difficult to ripen or that ripen unevenly, but its use is not at all general. This gas can be purchased in cylinders and it is commonly introduced about twice a day in the proportion of 1 cubic foot of gas to 5,000 cubic feet of room space. The same temperature and relative humidity should be maintained as in the ordinary ripening procedure. The use of

ethylene merely accelerates the normal rate of ripening under the prevailing conditions of temperature and humidity. It will not cause an immature-green tomato to become ripe and palatable or to attain the eating quality possible with a mature-green tomato.

RIPENING AND REPACKING PROCEDURE

In addition to having good ripening equipment, it is very important to obtain good, clean, mature-green [1] stock to ripen. Green tomatoes can be ripened so as to nearly equal field-ripened stock, if they are fully mature-green at time of harvest and are handled thereafter under proper conditions. The poor quality frequently found in tomatoes on the market during the winter months is chiefly due to their having been too immature when picked. Such fruit is slow to color—so slow, in fact, that much decay often develops before it can be marketed. The color that finally develops on such immature tomatoes is likely to be pale and unattractive, and the eating quality is poor. Very often during ripening these tomatoes take on a glossy crinkled appearance, which is commonly though erroneously attributed to chilling in transit. For these reasons it is important that the repacker who hopes to build up a reputation be particular that his green stock is well matured and as free as possible from disease and blemishes when shipped.

Much misinformation is abroad relative to the effect of temperature during transit on green tomatoes and their subsequent ripening after arrival at market. A number of investigations have shown that temperatures of 40° F. or somewhat lower maintained for several days longer than the usual transit period do not prevent tomatoes from ripening, but these temperatures do delay ripening somewhat when the exposures are more prolonged. It is believed therefore that a transit temperature of not lower than 50° is desirable.

When the green tomatoes are received on the market, they are usually in packed 30-pound lugs, and must be unpacked and unwrapped. For large quantities, unwrapping is accomplished by passing them on a conveyor belt beneath a suction duct where the air current pulls off the wrappers. The tomatoes then pass before sorters who pick out those that are already ripe enough to repack and dispose of and divide those remaining into three stages of maturity—green, turning (just showing color), and pink (one-fourth to one-half colored). All fruits showing any decay are discarded. Tomatoes in different stages of ripeness are returned to separate lug boxes and stacked in the ripening room so that those most nearly ripe are available first. This sorting process is repeated every day or two until the fruits are all ripened.

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[1] "No definite rules have been established for determining the proper maturity of tomatoes for shipment in the mature-green stage. However, according to the requirements of the United States standards for fresh tomatoes, a tomato is considered mature when the seed cavities have developed a jellylike or gluelike consistency and the seeds are well developed. In the practical test a sharp knife should be used and the tomato cut crosswise of the seed cells. If the pulp that surrounds the seeds has become jellylike and the seeds give way before the edge of the knife and are not cut in slicing, the tomato is considered to be mature enough to be shipped. For some varieties the presence of light color or whitish area on the blossom end of the fruit is considered a fairly reliable index of picking maturity. The size of tomato fruits is not a proper guide to the maturity, as it is the age that determines development." U. S. Dept. Agr. Farmers' Bulletin 1291, Preparation of Fresh Tomatoes For Market.

When the ripened tomatoes are ready for repacking, they should be carefully sorted to remove those that show any trace of decay. Minute specks of decay develop rapidly and will seriously interfere with the sale of the lot as a whole. Most of the decay that occurs in the ripening room enters the fruit through breaks in the skin incident to handling, or through growth cracks, or at the stem scar.

The carefully sorted ripened tomatoes, some of which are rewrapped, are then repacked, usually under the repacker's brand, in either the customary 30-pound wooden lugs or in cartons containing 1 or more pounds. Many of the smaller cartons contain a window in the lid to display the contents. The advantage of the small carton is that the fruit can be retailed in package units without being handled by the customer.

DECAY

The kinds of decay most commonly found in the ripening room are phoma rot, rhizopus rot, alternaria rot, fusarium rot, bacterial soft rot, and pleospora rot. Phoma rot is marked at first by small concave spots usually near the stem scar. As these spots enlarge they develop brownish-black centers with fruiting bodies showing; on ripe fruit these spots become water-soaked. Infection takes place through wounds, and sound fruit that is wounded at packing time may develop visible decay within 4 days.

Rhizopus rot is found mostly on ripe or nearly ripe fruit. It enters mechanical wounds, soon develops extensive soft watery decay with a coarse white fungus surface growth, and within a few hours causes complete collapse of the tissue.

Alternaria rot often develops in the moist stem scar or in bruises. It may follow as a secondary infection in lesions of other rots. The decayed area is dark brown to black with brownish-black mold over the surface, and usually extends into the interior of the fruit causing black or discolored seed cavities. Although alternaria rot may cause heavy loss in tomatoes held in a ripening room for prolonged periods, ordinarily it does not develop seriously during the time required for ripening mature-green tomatoes.

Fusarium rot is another decay of secondary nature usually developing in wounds at the stem scar or at the blossom end of the fruit under the humid conditions of the ripening room. At ripening-room temperatures this decay progresses rapidly and may completely destroy tomatoes within 4 days. It is marked by water-soaked, slightly sunken areas with white, cream-colored, or pinkish mycelium evident over the center of the lesions.

Bacterial soft rot usually attacks green fruit. In the beginning the decay is marked by a depressed, water-soaked area sharply delineated from the healthy tissue. In about 3 days the entire fruit will become a soft, watery, colorless mass that easily ruptures, and its foul-smelling contents will leak over the surrounding fruit.

Pleospora rot, occurring in tomatoes from the West, is of relatively recent commercial importance. It develops mostly near the stem scar and as a secondary infection in so-called shoulder bruises. At first this rot is light brown, but it later darkens as it becomes covered

with a black velvety growth of spores. In this stage it might be confused with phoma rot, but is distinguished by the absence of the glistening appearance of the latter.

SANITATION

Most of the decay occurring in the ripening room gains entrance through wounds in the fruit, or even minute scratches incident to ordinary handling. It follows, therefore, that careful handling to prevent mechanical injury as much as possible is important at all stages of the marketing process. Of equal importance is sanitation in the ripening room. Here the warm moist air favors the development of decay; therefore it is essential that the floors and walls be kept clean. All decayed fruits should be removed as soon as found, to prevent the spread of decay spores. From time to time it is advisable to scrub down the floors and walls, using strong soap or bleaching powder; this is usually all the disinfecting that is necessary.

SUMMARY

The commercial ripening of green-picked tomatoes is a specialized business that can be carried on without particular difficulty, provided certain fundamentals are understood.

The tomatoes must be mature-green when picked, otherwise they will not ripen properly. Good mature-green stock can be so ripened as to almost equal field-ripened tomatoes in quality. The poor quality frequently found in tomatoes on the market during the winter months is chiefly due to their having been too immature when picked.

Suggestions for the arrangement and management of the ripening room are given, including the use of very simple equipment.

Under average market conditions tomatoes are usually ripened at about 68° F., 4 or 5 days being required for mature-green tomatoes, and 2 days for turning tomatoes. If the maximum quality in flavor and color is desired, a temperature close to 60° is recommended. At this temperature the finished product will be firmer, will keep longer, and will develop less decay than if ripened at higher temperatures, but the time requirement will be considerably longer. With a very active market, temperatures of 70° to 72° may be used to give maximum speed in ripening.

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